

**THE MOMENTUM EFFECT EXEMPLIFIES THE  
INFLUENCE OF INVESTORS' IRRATIONAL BEHAVIOUR  
ON CHANGING PRICES OF SHARES AND STOCKS:  
AN ANALYSIS OF THE MOMENTUM EFFECT ON THE  
WARSAW STOCK EXCHANGE**

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**Abstract**

An efficient market should not show any anomalies. When new information reaches a market which is efficient, it should automatically translate into prices of assets, which ought to eliminate the possibility of gaining an advantage over other investors, thus preventing excess profits. However, studies on capital markets indicate that in reality it is possible to earn unusually high profits by taking advantage of certain anomalies which occur on a given market. Among such anomalies there is the momentum effect. This study performed on the Stock Exchange in Warsaw has shown that the momentum effect occurred throughout the entire analyzed time period. Positive returns demonstrated for investment strategies based on the momentum effect were unexplainable by the classical theory of finances. A correlation was found between the economic situation on the stock exchange and portfolio return rates, but it was too weak to attribute the effect to a single decisive factor. In addition, the returns from investments based on the momentum effect were statistically higher in January than in the other months, which was caused by the January effect, stimulating the occurrence of statistically higher returns at the beginning of a year rather than later on during the analyzed period of time. Research in this field carried out in other countries justifies the claim that there are many irrational factors which together create the momentum effect on the stock exchange. Thus, it is possible to conclude that irrational decisions may have strong impact on the pricing of stocks on the capital market. The momentum effect persisted throughout the entire analyzed period, although its power changed cyclically, which coincides with results of research carried out in other countries. The fact that the momentum effect did not disappear may suggest that the factors involved in its creation are an indispensable part of the market, and this seems to undermine the commonly accepted hypothesis about the efficiency of capital markets.

**JEL classification:** G02,G11, G14

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## INTRODUCTION

An efficient market should show no anomalies that could lead to achieving extraordinary gains when using the stock exchange data, especially historic data (Samuelson, 1965). However, studies across the world indicate that such anomalies are rather widespread (Agrawal, Tandon, 1994; Balaban, 1994; Keong, Yat, 2010; Latif et al., 2011; Choudhry, 2000).

The literature dedicated to this subject distinguishes five categories which - according to the classical finance theories - do not reflect correctly prices of stocks and shares. These are (Szyska, 2003):

- 1) time anomaly,
- 2) anomalies connected with the specific nature of companies,
- 3) anomalies connected with a delayed response of investors to new information,
- 4) overreaction of the market,
- 5) the momentum strategy.

Time anomalies, which belong to the first group, are the basic category of anomalies. They are characterized by the dependence which appears in the first weeks of the year. It has been verified that unusually high gains are achievable in specific moments of time. The principal cause is said to be taxation, namely a tendency to sell stocks in late December and resume investment in the new year. Another theory claims that the approach to pricing among professional investors changes at the end of a year, which is most probably due to paying more attention to the next year's forecasts (Haugen, Lakonishok, 1988).

Buczek demonstrated the presence of the January effect at the Stock Exchange in Warsaw in 1994-1995 and in 1999-2004 (Buczek, 2005). In the former period, certain forms of anomalies were noticed, but an insufficient amount of data did not allow the researcher to demonstrate any statistical significances. In the latter time period, the rate of return in the early months of each year was on average 6.2%, falling to 0.8% in the later months. Additionally, another period of above average returns on investment was December, which may have been caused by the growing awareness of the January effect among investors, who tried to buy stocks 'awaiting the January effect'. Thus, it is possible to claim that the Polish stock exchange experiences a December-January effect.

The second type of anomaly mentioned arises from specific characteristics of companies. An example of this sort of anomaly is the effect of small companies, which was documented in 1981 by R. Banz (Banz, 1981), who noticed that stocks of small companies gained higher rates of return than large ones. The founders of the efficient markets theory, Fama and French, also pointed to the occurrence of such anomalies. This is particularly important in view of the contradiction of the results with the CAMP model, broadly accepted by academic circles (Fama, French, 1992). Another example is the anomaly associated with the book to market value ratio (known as the book-to-price B/P ratio) or its reverse variant (the P/B ratio). The book value is the shareholders' input higher by the historic profits of the company but less by the dividends paid, whereas the market price reflects past and future prospects of the company. When the market price is much higher than the book value, it means that investors consider a given company a prospective one (companies with growth potential). In turn, when the B/P ratio is high, it means that its book value is high but the market price relatively low. Such companies are known as 'companies with value potential'. Companies with a high B/P ratio enable one to obtain above average rates of return compared to companies with a low B/P ratio. This regularity has been widely examined on the American market, giving rise to numerous controversies, mainly by being inexplicable with the aid of the beta coefficient (Capaul, Rowley, Sharpe, 1993).

The third group of anomalies are the ones connected with a delayed response of investors to new information. This category embraces numerous and diverse reactions on behalf of investors observed over many years all across the world, including on the Warsaw Stock Exchange. An example could be an excessively slow response to changing financial results. It has been determined that despite the fact that investors observe attentively the financial position of a company, when new information appears (be it even crucial), its influence on prices may be considerably time shifted. It is estimated that more or less three months elapse before new information is incorporated within the price of the company's shares. The reason is most probably an excessively conservative attitude of investors to companies (Bernard, Thomas, 1989).

A similar development takes place when details on the level of a dividend emerge. Studies on the American

stock exchange market have shown that assets of companies which begin to pay dividends generate above average profits in three consecutive years. In contrast, once they cease to pay dividends, they achieve smaller benefits in the following three years (Michael, Thaler, Womack, 1995). On the Warsaw Stock Exchange, this anomaly began to emerge after 2004; prior to that year, probably because of the insufficient knowledge of finance among investors, dividends had not had any essential effect on prices of stocks (Buczek, 2005).

The market's overreaction is an anomaly exemplified by the loser-winner effect. It means that using only historic data it is possible to attain above average profits. This strategy has been detected in many countries around the world. Studies on the Polish market have shown that the loser-winner effect was absent from the Warsaw Stock Exchange in 1995-2003. This may have been a result of the then highly volatile economic situation in Poland in contrast to European or American markets (Buczek, 2005).

The last group of anomalies is the momentum strategy/effect. This strategy consists of buying stocks with the highest return rate in the last n-months and selling ones which had the lowest rate of return in the same period (De Bondt, Thaler, 1985; Johnson, 2002; Kelsey, Kozhan, Pang, 2011; Lehmann, 1990, Rouwenhorst, 1999). The occurrence of this effect is attributed to an insufficient response of investors to the information about given companies. As a result, prices are not adjusted immediately and it is possible to obtain above average return rates from investing in winners' stocks and short selling losers' stocks. Studies carried out on this subject in 2001-2004 by Buczek (2005) and in 2003-2010 by Wójtowicz (2011) demonstrated the existence of the momentum effect during the analyzed time periods on the Warsaw Stock Exchange.

## THE PURPOSE AND WORKING HYPOTHESES

The objective of this study has been to identify and possibly assess the power, nature and determinants of the momentum effect on the Warsaw Stock Exchange. The following hypotheses were assumed:

**H1:** The momentum effect occurs at the Warsaw Stock Exchange;

**H2:** The momentum effect is the strongest in short time periods when a portfolio is being formed;

**H3:** The power of the momentum effect at the Warsaw Stock Exchange is variable;

**H4:** The changing effectiveness of strategies based on the momentum effect at the Stock Exchange in Warsaw is caused by other factors apart from the changing economic situation;

**H5:** The momentum effect at the Warsaw Stock Exchange is influenced by the January effect.

## RESEARCH METHODOLOGY

The subject of this research was the fluctuation of prices noted on the Warsaw Stock Exchange. The analysis used data originating from 2000 to 2013. The results of continuous trading according to closing prices on the 15<sup>th</sup> day of each month were submitted to the analysis. Whenever it was impossible to form ten complete portfolios due to the lack of data, a given time period was excluded from the study. Only companies which participated in continuous trading while a portfolio was being formed were analyzed. The unit value of a stock was over 5 PLN, which was done in order to eliminate distortion of results by junk companies and companies with little liquidity. Another group of firms excluded from the research consisted of the ones in which a change in the stock exchange price while creating and holding a portfolio exceeded 200%. The reason was to eliminate the companies which had been an object of extreme speculation, as they could also distort the analytical results.

In order to detect the occurrence of the momentum effect on the Warsaw Stock Exchange, portfolios of stocks and shares were made depending on how long it took to form a portfolio (K) and how long it was kept (J). The time periods analyzed were 3, 6, 9 and 12 months for both factors. The creation of a portfolio commenced at time  $t_0$  and was repeated every month until time  $t_{0+K}$ . In the time  $t_{0+K}$ , the returns obtained during the portfolio formation period were calculated from the formula (1):

$$w_x = \frac{v_{t-K} - v_t}{v_{t-K}} \cdot 100\% \quad (1)$$

where:

$w_x$  – percent change in the value of an asset during the portfolio formation period,

$v_{t-K}$  – value of the asset during the time period t-K,

$v_t$  – value of the asset at time t.

Next, the results obtained from the assets were divided into deciles, where companies with the highest returns were gathered in the decile D1, and those with the lowest returns were aggregated in the decile D10. This segregation was carried out until the period t+J, in which the results were averaged (2):

$$p_{K,J,D} = \frac{\sum w_{x,t,D}}{N_{K,J,D}} \quad (2)$$

where,

$\pi_{K,J,D}$  – average returns of decile D in the analyzed period for strategy K/J,

$w_{x,t,D}$  – per cent change in asset x during time t, assigned to decile D,

$N_{K,J,D}$  – number of assets in decile D for strategy K/J.

Data for 16 strategies, each of which contained averaged results for all ten deciles, were eventually obtained. Afterwards, statistical verification was performed by testing the significance of means.

The analysis comprised 939 assets of companies which were quoted on the stock exchange in 146 time periods.

## RESULTS AND DISCUSSION

The observations of the prices of assets on the Warsaw Stock Exchange enabled the author to detect some untypical changes, which are referred to as short-term momentum effect (Tab. 1).

**Table 1: Average monthly returns for individual momentum effect strategies**

J	Portfolio	Number of months after which a given portfolio was sold			
		K = 3	K = 6	K = 9	K = 12
Average monthly returns (%)					
3	D1	3 <b>(3,672)*</b>	4,9 <b>(3,192)</b>	6,1 <b>(1,922)</b>	7,7 (1,386)
	D5	0,9	2,3	4,0	7,5
	D10	-0,6	-0,3	2,1	3,6
	D1-D10	3,6	5,2	4,0	4,1
6	D1	1,2 <b>(2,724)</b>	2,4 <b>(2,141)</b>	3 (1,385)	2,8 (0,886)
	D5	0,4	1	1,8	3,1
	D10	-0,1	0,6	1,5	2,5
	D1-D10	1,3	1,8	1,5	0,3
9	D1	0,8 <b>(1,67)</b>	1,3 (1,283)	1,7 (0,62)	2,5 (0,068)
	D5	0,2	0,8	1,7	2,2
	D10	0,2	0,7	1,2	2,4
	D1-D10	0,6	0,6	0,5	0,1
12	D1	1,8 (-0,303)	1,1 (1,282)	1,3 (0,461)	1,5 (0,664)
	D5	2,0	0,8	1,4	1,8
	D10	2,0	0,5	1	1,4
	D1-D10	-0,2	0,6	0,3	0,1

\*Bolded values are statistically significant (significant at the level of significance  $p=0.05$  or  $p>0.05$ ). A higher value of the test means a higher reliability of the analyzed variables.

Source: Own studies based on performed research

Column J shows the duration of portfolio formation after which returns from individual stocks are juxtaposed relative to the time period, and stock portfolios are created based on this juxtaposition. The value K stands for the number of months after which a given portfolio is sold and the averaged value of these returns is set in a table. All the results were divided between the deciles, although – for the sake of simplicity – only the portfolios of ‘past winners’, i.e. the companies in D1decile, the 10% of companies which had demonstrated the highest returns, the past losers (D10 decile) and the D5 middle portfolio stocks were presented. In addition, the D1-D10 column shows the average difference between returns from the extreme 1st and 10th deciles. For strategy D1, the result of t-Student test showing the statistical difference between the average values for D1 and D10 is given in brackets under the returns.

The results show that all the analyzed strategies except one (12/3; J = 12, K = 3) generated a higher profit for the past winners than past losers, but the difference was statistically significant in only six out of sixteen cases. Taking such responses of the market as evidenced in this research, it is impossible to speak about any efficiency of the market, even in its weakest form.

Despite the results, it was only in the case of short-term strategies that a significant difference between portfolios D1 and D10 appeared. This means that the momentum effect on the Polish stock exchange market is observable only in short periods of time.

The analysis of the results achieved by the companies revealed that the momentum effect is the strongest under strategies 3/3, 3/6 and 6/3, 6/6. The highest financial profits are generated by strategies 3/3 and 3/6, where the difference in the average return between the extreme portfolios is 0.036 and 0.052, respectively, which translates to an output over 3.6 and 5.2% higher per month.

The results show some differences in the specific

nature of the effect versus the American stock exchange market, examined by Jegadeesh and Titman, which may have been due to certain differences between the applied methodologies. Undeniably, however, the momentum effect can be said to appear in a short time horizon (Jegadeesh, Titman, 2001).

In order to verify the short-lasting presence of the momentum effect, its stability in time was checked. It was therefore necessary to check whether the differences in rates of return on stocks after K time period (months of creating a portfolio) were not incidental, single price fluctuations. Unfortunately, due to a severe shortage of information, it was impossible to divide the data originating from the years 2000-2003 into deciles. The reason was the lack of data about some of the companies, which prevented the formation of ten complete portfolios.

Within the 12 years covered by the research, the D1 portfolio yielded higher profits in all the three strategies than the portfolio of losers (D10). In all strategies except 9/3, the D1 yield to D10 yield ratio was over 70% (Table 2).

It is important to underline that the momentum effect was present in all the years covered by the research and did not disappear in time. Both portfolios were strongly correlated with each other in terms of the directions of trends, although the Decile 1 portfolio was more sensitive to positive growth stimulants. At the end of 2003 two very big differences in returns from both portfolios were notable, which stemmed from intense speculative growths among groups of companies. However, these increases did not affect the statistical significance of differences between the portfolios, influencing only the profitability of strategies.

The winners' portfolios, in each of the analyzed strategies, throughout most of the time, generated higher monthly rates of return than the losers' portfolios. The said ratio ranged from 66.96% in strategy 9/3 to 76.67%

**Table 2: Differences in returns from portfolios in momentum effect strategies**

Strategies	3/3 n:122	3/6 n:120	3/9 n:119	6/3 n:120	6/6 n:118	9/3 n:115
<b>Number of months in which D1 yield &gt; D10 yield</b>	93	92	84	91	84	77
<b>Percentage of months in which D1 yield &gt; D10 yield</b>	76,23%	76,67%	70,59%	75,83%	71,18%	66,96%

Source: Own studies based on performed research

in strategy 3/6.

The results of our analysis imply that the momentum effect is not constant in time. It is possible to notice such time periods when rates of return on stocks in the winners' portfolio are very high, but in other time periods gains from portfolios based on the momentum effect are near zero or rates of return are negative.

One of the factors that can have a strong effect on seasonality is the situation on the stock exchange market.

Obviously, the momentum effect cannot be unaffected by what happens at the stock exchange. It is vital to determine whether the untypical gains of the strategy based on the momentum effect are just a result of the higher increase in the value of companies with strong standing during an upward market trend. In the case of the Warsaw Stock Exchange, a study was carried out on the correlation of changes in the WIG index relative to changes in the rates of return from portfolios D1 and D10 (Table 3).

**Table 3: The correlation of portfolios with the situation on the stock exchange**

Strategy	3/3		3/6		3/9		6/3		6/6		9/3	
	D1	D10	D1	D10	D1	D10	D1	D10	D1	D10	D1	D10
<b>The Pearson correlation coefficient</b>	0,38	0,49	0,39	0,42	0,07	-0,05	0,48	0,49	0,33	0,42	0,5	0,5
<b>Z-score test</b>	<b>4,56</b>	<b>6,21</b>	<b>4,53</b>	<b>4,978</b>	<b>0,083</b>	<b>-0,06</b>	<b>5,88</b>	<b>6,14</b>	<b>3,76</b>	<b>5</b>	<b>6,2</b>	<b>6,18</b>

Source: Own studies based on performed research

For all the strategies except strategy 3/9 the correlation between the profits obtained from the portfolios and the situation on the stock exchange (expressed as the fluctuations of the WIG index) was statistically significant. The study showed that there is a semi-strong correlation, meaning that the situation on the stock exchange has some effect on returns from the portfolios. However, there were more determinants. Especially wherever the strength of correlation for two extreme portfolios is identical, it is impossible to claim that the stock exchange current situation is the factor that is responsible for the presence and changes in the strength of the momentum effect. Changes in the portfolios would be almost identical and such strong fluctuations would not occur unless other factors were involved. In such a situation it is impossible to explain discrepancies in a one-zloty investment in both portfolios. The differences prove that the stock exchange situation alone cannot justify the momentum effect and there must be other factors which induce changes in the strength of the said effect.

Should the stock exchange situation be insufficient to explain these changes, then a behavioural factor needs to be considered. This would require quantification of the effects of underestimating and overreacting to new stock exchange information (positive and negative) by investors. Among such behavioural factors there is the January effect, indicated by Jegadeesh and Titman as having a strong impact on returns from portfolios during

the time it occurred (Jegadeesh, Titman, 2001).

Additionally, a more detailed study by Glaser and Weber (2003) enabled the researchers to observe an equally strong January effect on results of momentum strategies on the US market. Their investigations showed that because of a high overreaction of the market in January, momentum strategies during the formation of a portfolio generated much higher returns than an average return during the remaining periods of time (Glaser, Weber, 2003).

All statistically significant strategies showed a higher return rate in the early months of a year rather than later (Table 4).

This effect was particularly notable in the strategies where the portfolio building period is short (3/3, 3/6 and 3/9). As the period of forming a portfolio is extended, the differences between return rates diminish. The strongest influence of the momentum effect appears in the 3/3 strategy with the shortest period of keeping portfolios, where the difference between January and the other months is 3.18%. In turn, the 6/6 and 9/3 strategies, where the whole portfolio keeping period lasts for 12 months and the portfolio building takes more than 3 months, the January effect is weaker; in the two strategies the difference was 0.87% and 0.98%, respectively. This means that the January effect has an increasingly weaker influence on the momentum effect over a longer period of time.

**Table 4: The average return rate in a month**

Strategy	The average return rate in a month (%)		The difference between January and the rest of the year (%)
	January	February – December	
3/3	3,93	0,75	3,18
3/6	4,06	2,49	1,57
3/9	6,15	4,05	2,1
6/3	1,71	0,36	1,35
6/6	2,14	1,27	0,87
9/3	1,28	0,3	0,98

Source: Own studies based on performed research

## CONCLUSIONS

The momentum effect is a subject thoroughly analyzed by researchers in countries around the world. More and more studies highlight its statistically significant influence on stock exchanges in many developed and developing economies, e.g. in the USA, South Korea, Canada, India and Germany.

The current research has demonstrated that the momentum effect occurred also on the Warsaw Stock Exchange. An investment strategy based on its occurrence yielded positive investment results. Moreover, it has been shown that the momentum effect was stable in time. Similar results in a short-time period were achieved by Jegadeesh and Titman in studies carried out on the US stock market (Jegadeesh, Titman, 2001).

Our study has shown that the winners' portfolios surpassed the future losers' portfolios in all the analyzed strategies except for strategy 12/3. However, the statistical analysis proved that only the differences in portfolios for strategies 3/3, 3/6, 3/9, 6/3, 6/6 and 9/3 could be considered significant. We may therefore speak about the presence of the momentum effect on the Polish capital market. These results overlap in the shortest time period with the results generated by investigations carried out in other countries, but there are divergences appearing in the long run. This may be due to the Polish stock market not yet being as developed as the American market.

At the Warsaw Stock Exchange, particularly large differences between the extreme portfolios appeared for the strategies with a short portfolio building period. The biggest differences in return rates were determined for strategies 3/6 – 5.2%, 3/9 – 5%, and 3/3 – 3.6%. The other strategies did not show such significantly different results. This may have been attributed to the fact that the momentum effect on the Polish stock exchange has a more short-lasting character. Studies on the stability of the momentum effect over time showed that while directions of changes in return rates in the deciles 1 and 10 are concordant, there is some significant discrepancy. Over the analyzed period of time, differences between the two extreme deciles grew larger or smaller. Besides, the said differences were varied in particular strategies.

The simulation of a one-zloty investment showed that the past winners' portfolio was superior to the losers' portfolio. After 12 years, each zloty invested in the first decile generated 14.50 PLN while the investment in the tenth decile brought only 2.20 PLN. Profitability fluctuations followed the same direction, although the decile of winners was much more dynamic and responsive to impulses than the decile composed of losers.

Our analysis of hypothetical stimuli affecting the momentum effect revealed a moderate influence of the WIG index on both extreme portfolios. It would be wrong to maintain that the WIG index played an exclusive role in the creation

of the momentum effect. This becomes particularly evident when the values of the Pearson's coefficient for either of the portfolios are nearly identical.

Likewise, the January effect did not have a decisive influence on the results produced by the portfolios, although all of the analyzed strategies showed higher rates of return while being affected by the January effect than during the rest of the year. This difference was the biggest for the shortest 3/3 strategy, followed by the 3/9 strategy. For the former strategy, the difference between January and the remaining months was 3.18%, while for the 3/9 strategy, the said difference reached 2.1%. The other strategies showed an average difference between

January and the rest of the year around 1.19%. These results are not strong enough to affect the overall results of the strategies.

The analysis of overreactions and underreactions on behalf of investors provides the ground for a satisfactory explanation of the examined phenomenon. The fact that there are passive and active investors on the stock exchange who integrate information at a different rate means that values of stocks are revalued over a longer period of time. Theoretically, therefore, the momentum effect is a result of integrating information by investors who take advantage of the fundamental analysis.

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